

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Nutrition and Health Sciences -- Faculty
Publications

Nutrition and Health Sciences, Department of

7-22-2019

Diets and Irritable Bowel Syndrome

Zahra Darabi

Shahid Behehshti University of Medical Sciences

Amin Mokari-Yamchi

Shahid Behehshti University of Medical Sciences

Masoomeh Hajizadehghaz

University of Nebraska-Lincoln

Arezoo Rezazadeh

Shahid Behehshti University of Medical Sciences, arezoo.rezazadeh@gmail.com

Follow this and additional works at: <https://digitalcommons.unl.edu/nutritionfacpub>



Part of the [Human and Clinical Nutrition Commons](#), [Molecular, Genetic, and Biochemical Nutrition Commons](#), and the [Other Nutrition Commons](#)

Darabi, Zahra; Mokari-Yamchi, Amin; Hajizadehghaz, Masoomeh; and Rezazadeh, Arezoo, "Diets and Irritable Bowel Syndrome" (2019). *Nutrition and Health Sciences -- Faculty Publications*. 201.

<https://digitalcommons.unl.edu/nutritionfacpub/201>

This Article is brought to you for free and open access by the Nutrition and Health Sciences, Department of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nutrition and Health Sciences -- Faculty Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.



Diets and Irritable Bowel Syndrome

Zahra Darabi¹, Amin Mokari-Yamchi², Masoomeh Hajizadehghaz³, Arezoo Rezazadeh^{2*}

1. Student Research Committee, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Department of Community Nutrition, National Nutrition and Food Technology Research Institute, Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3. Department of Nutrition and Health Sciences, College of Education and Human Sciences, University of Nebraska-Lincoln, NE, USA.

ARTICLE INFO	ABSTRACT
Article type: Review Article	Introduction: Irritable bowel syndrome (IBS) is the most common functional gastrointestinal disorder, which is characterized by the presence of abdominal pain or discomfort associated with altered bowel habits. This systematic review aimed to assess the nutritional factors (dietary patterns and food groups) associated with IBS.
Article History: Received: 09 Jan 2019 Accepted: 09 Apr 2019 Published: 22 Jul 2019	Methods: Articles were collected via searching in databases such as Medline, EMBASE, CINAHL, ProQuest, PubMed, Scopus, ScienceDirect, and Google Scholar using relevant keywords and phrases, including irritable bowel syndrome, pattern, intake, behavior, habit, meal, nutrition, food, lifestyle, and prevalence. The articles were confined to the original human studies that were published in English since 2010. Duplicates and unrelated materials were excluded.
Keywords: Dietary Patterns Food Groups Irritable Bowel Syndrome	Results: Consumption of processed meat, fast foods, and legumes has been reported to increase the risk of IBS. However, the correlation between the consumption of milk, fruits, and vegetables has not been conclusive. Moreover, the association between cereal intake and risk of IBS varies depending on the type of cereals. The results also indicated that fast food dietary patterns increased the risk of IBS, while lacto-vegetarian dietary patterns reduced the risk of IBS.
	Conclusion: According to the results, the effects of some food groups on IBS are unclear. In addition, research in this regard is limited to food patterns, and further investigations are required in order to reach conclusive results.

► Please cite this paper as:
Darabi Z, Mokari-Yamchi A, Hajizadehghaz M, Rezazadeh A. Diets and Irritable Bowel Syndrome. J Nutrition Fasting Health. 2019; 7(3): 121-129. DOI: 10.22038/jnfh.2019.37551.1165

Introduction

Irritable bowel syndrome (IBS) is a digestive system disorder, which is characterized by chronic abdominal pain, bloating, and altered bowel habits, adversely influencing the quality of life of the patients (1). Patients with IBS often have diarrhea, constipation or intermittent diarrhea and constipation. Accordingly, these patients could be classified into three groups, including patients with predominant constipation, those with predominant diarrhea, and patients with both diarrhea and constipation (mixed type) (2).

Previous studies have indicated that the prevalence of IBS is 1-22% across the world. For instance, the prevalence of IBS has been reported to be 10.9% in Middle Eastern countries, such as

Iran (3). The incidence of IBS has been reported to be higher in women compared to men. Furthermore, most IBS symptoms tend to appear in the third decade of life in individuals. Considering that IBS has no specific symptoms, if the patient is not diagnosed with other digestive tract disorders (e.g., colitis, celiac, and cancer), IBS is the next probable diagnosis (4, 5).

The etiology of IBS remains unknown. However, some of the main risk factors in this regard include the family history of IBS, dietary habits, gut microbes, neuroendocrine system disorders, mental impairment, anxiety, and stress. The main causes of IBS may be classified as central and peripheral. The central causes of IBS include inappropriate nervous system responses to neural impulses and hypothalamic-pituitary-adrenal disorders. The peripheral causes of IBS

* Corresponding author: Arezoo Rezazadeh, Assistant Professor, Department of Community Nutrition, School of Nutrition & Food Industry, Shahid Beheshti Medical University, Tehran, Iran. Code Postal: 19395-4741. Tel: +98 21 2236 0656, Ext. 249. Email: arezoo.rezazadeh@gmail.com

include increased visceral sensitivity, low-grade inflammation, and epithelial dysfunction. Reports suggest that factors such as prolonged fever, anxiety, and depression could also increase the risk of IBS (3).

Despite numerous investigations regarding the identification of the causes of IBS, the findings in this regard are inconclusive. Several studies have denoted that sleep patterns, dietary habits, and other lifestyle factors may increase the risk of IBS (1). Moreover, it is likely that lifestyle changes in terms of dietary habits and eating behaviors could effectively improve the quality of life of the patients with IBS.

The present study aimed to evaluate the correlation between nutritional factors (dietary patterns and food groups) and IBS.

Materials and Methods

This systematic review study was conducted via searching in databases such as Medline, EMBASE, CINAHL, ProQuest, PubMed, Scopus, ScienceDirect, and Google scholar for the articles published until March 2018. The articles were focused on original human studies and published in English, which were retrieved by using relevant keywords or phrases, including Irritable bowel syndrome, pattern, intake, habit, meal, nutrition, food, lifestyle, and prevalence.

The literature search resulted in a limited number of studies in this regard. Therefore, the systematic review was not confined to only one type of study design, and all types of studies were considered in the search strategy. The articles meeting the inclusion criteria were selected, and the reference lists of potentially eligible articles were also checked in order to find additional related articles. Afterwards, two reviewers, who were subject matter experts, analyzed the titles and abstracts of the initially selected articles so as to confirm the final articles for the study. The articles that only assessed single nutrients were

excluded. Duplications were also checked, and unrelated articles in terms of the content were also excluded.

Various data were extracted from the selected articles, including the characteristics of the subjects (e.g., sample size, age, and gender), study design, methods of dietary assessment, various dietary data (e.g., dietary patterns and food groups), and association of dietary intakes and patterns with IBS. Moreover, the obtained data were categorized based on dietary patterns and food groups.

Results

The literature search for the related studies yielded 547 articles. In total, 11 articles were included in the study. Based on the content of the extracted articles, the results of the studies were reported in two separate categories of dietary patterns and food groups in regards to IBS. With the exception of one article, the sample size of which consisted of women only, all the retrieved studies were conducted on both men and women. The participants were aged ≥ 18 years, and the studies involved the measurement of IBS symptoms using the Rome III or Rome II questionnaires (2), as well as various other questionnaires, to assess dietary intakes. For instance, the food frequency questionnaire was used in three studies, while two of the studies were semi-quantitative, and one was qualitative (4-6). In addition, two studies used another type of dietary assessment, including the brief self-administered diet history questionnaire (BDHQ) (7, 8). Multi-section questionnaires were also applied in another study, one of which involved the assessment of dietary intakes. In one study, the assessment method was a list of food items that might cause the symptoms of IBS. In this assessment, patients with IBS and healthy subjects were required to record their perceptions toward the role of diet in their IBS symptoms (1, 3, 9, 10).

Table 1. Reviewed Studies Regarding Dietary Patterns and Food Groups

Reference	Participants and Their Gender	Country	Study Design	Dietary Assessment Method	Dietary Patterns/Food Groups	Results
Studies on Dietary Patterns						
Ryu Satake et al. (2015)	993 Subjects (382 men, 611 women)	Japan	Cross-sectional	Self-administered Diet History Questionnaire (BDHQ)	1. Healthy 2. Western 3. Alcohol and Accompanying	Alcohol and accompanying dietary pattern was inversely associated with the risk of IBS.
Esmailzadeh Ahmad et al. (2015)	3,846 Subjects	Iran	Cross-sectional	Dish-based Semi-quantitative Food Frequency Questionnaire (DS-FFQ)	1. Fast Food 2. Traditional 3. Lacto-vegetarian 4. Western	Lacto-vegetarian dietary pattern was inversely associated with the risk of IBS; Fast food dietary pattern was positively associated with IBS.
Camille Buscail et al. (2017)	44,350 Subjects (9,643 men and 34,707 women)	Finland	Cross-sectional	Questionnaire Consisting of 29 Food Groups	Healthy, Western, and Traditional	Western dietary pattern was positively associated with the risk of IBS; Traditional dietary pattern was positively associated with IBS in women.
Studies on Food Groups						
Ioan Chirila et al. (2012)	193 Subjects (80 men and 113 women)	Romania	Cross-sectional	- FFQ	Processed Meat, Potatoes, Cereals, Canned Fruits, Milk, and Legumes	Intake of processed meat, grain bread, pasta, cereals, canned fruits, milk, and legumes was positively associated with the risk of IBS.
Yukiko Okamiet et al. (2011)	1,768 Students (650 males and 1,118 females)	Japan	Cross-sectional	Questionnaire Consisting of 69 Items (23 items on dietary habits and frequency of food items)	Milk, Meat, Fish, Egg, Green-Yellow Vegetables, Fruit, and Processed Food Products	Women: Intake of fish, fruit, milk, and green-yellow vegetables was inversely associated with the risk of IBS; Intake of processed food products was positively associated with the risk of IBS;
Yu-Bin Guo et al. (2015)	78 IBS Patients and 79 Healthy Subjects			FFQ and Chinese Lifestyle Habits Questionnaire	Fruits, Vegetables, Legumes, and Tea	Men: Not significant. Intake of fruits, vegetables, legumes, and tea was significantly higher in IBS patients than controls.

Reference	Participants and Their Gender	Country	Study Design	Dietary Assessment Method	Dietary Patterns/Food Groups	Results
Case-control						
Hayes et al. 2014	135 IBS patients 111 healthy subjects	China	Cross sectional	perceptions of the role of diet in their gastrointestinal symptoms	Cereal, spicy food, vegetables, fatty food	Cereal, spicy food, vegetables, fatty food significantly cause gastrointestinal symptoms
		Ireland				
Farnaz Khademolhosseini et al. (2010)	1,978 Subjects (709 men and 1,269 women)	Iran	Cross-sectional	Questionnaire with Validity and Reliability	Fruits and Vegetables	Intake of fast foods was positively associated with the risk of IBS; Intake of fruits and vegetables was inversely associated with the risk of IBS.
Zhaoqiu Zheng et al. (2015)	1,082 Subjects (837 men and 245 women)	Japan	Cross-sectional	Brief self-administered Diet History Questionnaire (BDHQ)	Rice, Bread, Chinese Noodles, AND Japanese Wheat Noodles	Intake of rice, bread, pasta, and buckwheat noodles was positively associated with the risk of IBS.
Katsuhisa Omagari et al. (2013)	245 Subjects (women only)	Japan	Cross-sectional	Semi-quantitative FFQ	Milk and Eggs	Intake of milk and eggs was inversely associated with the risk of IBS.
Marion J. Torres et al. (2018)	1,870 IBS Patients and 34,578 Healthy Subjects	Finland	Case-control	Self-administered 24-Hour Dietary Records and 24-Hour Records	Milk and Fruits	Intake of fruits and milk was significantly higher in IBS patients than controls.

The Association of Dietary Patterns and IBS

Two of the selected studies investigated the association of an overall dietary pattern with the incidence of IBS. A cross-sectional study conducted by Satake et al. (2015) on a Japanese population reported three major dietary patterns in the participants, including healthy diet, western diet, and alcohol and accompanying diet. In the mentioned research, the participants with higher adherence to the alcohol and accompanying dietary pattern were at the lower risk of IBS (53%; odds ratio [OR] =0.47; confidence interval [CI]: 0.24-0.90). This dietary

pattern was characterized by the high intake of beer, oily fish, squid/octopus/shrimp/shellfish, Shochu, lean fish, chicken, and small fish with bones (7).

Another cross-sectional study in this regard explored the correlation between dietary patterns and IBS. The prevalence of IBS was measured in a general population consisting of Iranian adults, who were employed in 50 healthcare centers. In the mentioned study, four dietary patterns were identified, including the fast food dietary pattern, traditional dietary pattern, lacto-vegetarian dietary pattern, and western dietary pattern. According to the

findings, the individuals in the highest quartile of the fast food dietary pattern were at the higher risk of IBS compared to those in the lowest quartile ($P=0.05$). In addition, an inverse association was reported between the lacto-vegetarian dietary pattern and risk of IBS ($P=0.01$), while no significant associations were observed between the traditional and western dietary patterns with the risk of IBS (6).

Another cross-sectional study in this regard demonstrated that the western dietary pattern was positively associated with the incidence of IBS ($P<0.0001$) (11).

The Association of Food Groups and IBS

Among 11 reviewed articles, eight articles were about food groups and IBS, two of which were case-control studies, and the other six articles were cross-sectional studies.

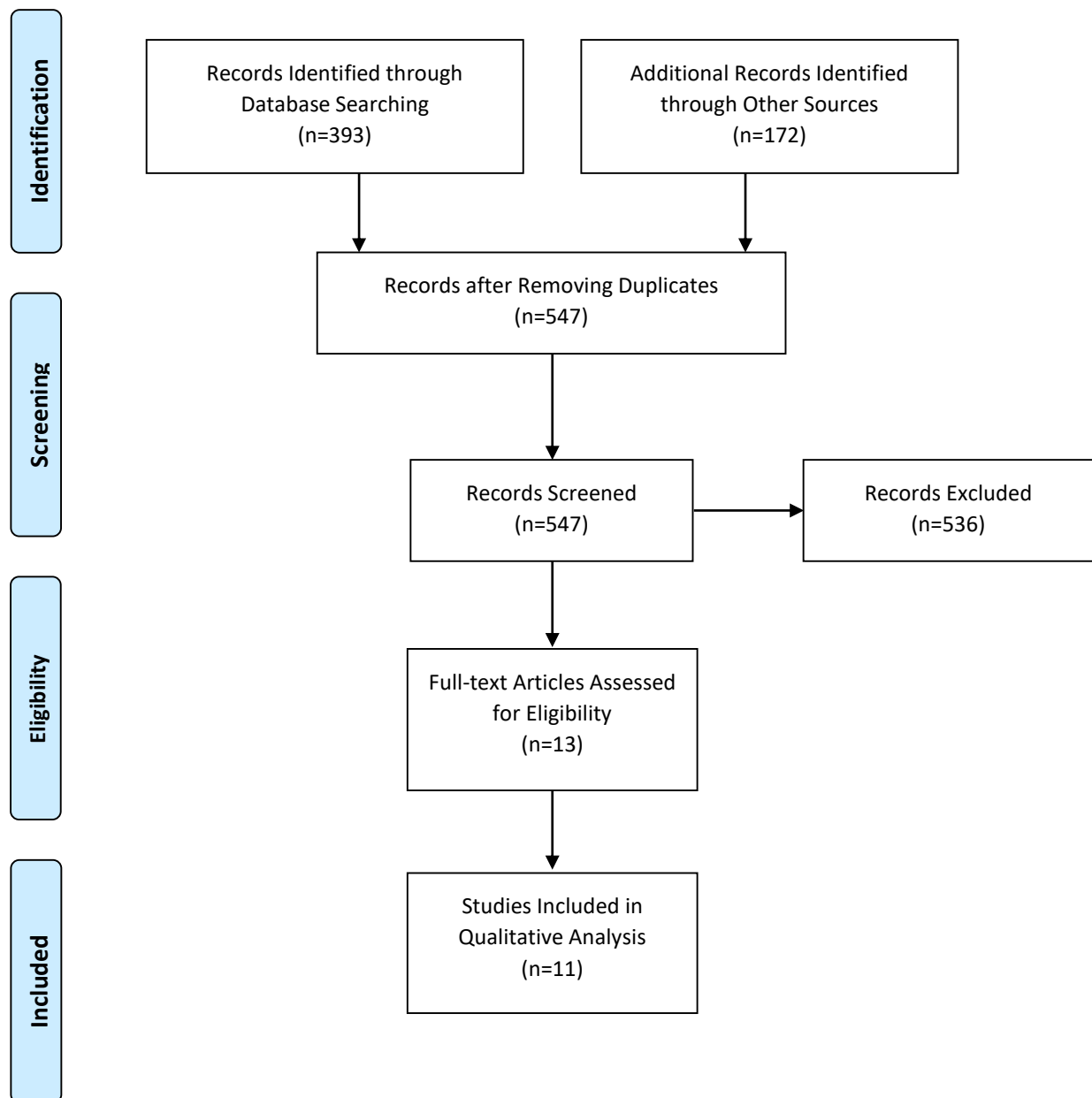
Regarding some food groups, the mentioned studies proposed conflicting results. For instance, one study demonstrated that the prevalence of IBS in the men and women consuming high portions of fruits and vegetables was significantly lower compared to those who consumed less fruits and vegetables ($P=0.027$). On the other hand, the findings of some studies indicated that the intake of milk, fruits, greens, and yellow, leafy vegetables was significantly lower in the women of the IBS group compared to healthy women ($P<0.05$). However, another study showed a significant, positive association between the consumption of fruits and risk of IBS ($P<0.001$).

Another research in this regard showed that the consumption of fast foods, processed meat, canned foods, and processed food products was positively associated with the risk of IBS (3, 5, 10). Another study, in which the subjects were

required to record their perception toward the role of diet in their IBS symptoms, indicated that the intake of cereals, spicy foods, vegetables, and fatty foods caused significant gastrointestinal symptoms in the patients with IBS, while no assessment was used in the study (9). According to the findings of another research, the intake of milk, yogurt, and fruits was lower in the patients with IBS compared to healthy controls (12).

The current findings regarding the association of egg and fish consumption with IBS are contradictory, so that the results of one study indicated that the intake of fish in women was significantly lower in the IBS group (8), while another study showed that the consumption of eggs and fish had no significant association with the incidence of IBS (5). Moreover, both of the studies examining the correlation of legume intake with IBS showed that the higher consumption of legumes was significantly associated with the higher risk of IBS (1, 5).

The association between various food items of the cereal food group and IBS has been investigated in two studies. In the first study, which was conducted by Zheng et al., the intake of rice, bread, pasta, and buckwheat noodles was associated with the higher prevalence of IBS. After adjustment for carbohydrate and plant protein intake, no significant association was observed between the intake of rice, bread, and pasta with the incidence of IBS. However, the association between the intakes of buckwheat noodles with IBS remained significant. Furthermore, the intake of Japanese wheat noodles had no significant correlation with IBS before and after adjustment for carbohydrate and plant protein intake. In another study, IBS was reported to be significantly associated with the higher intake of grain bread, pasta, and cereals (5, 8).



Discussion

Overall, the results of the reviewed studies indicated that the consumption of processed meat, fast food, and legumes increased the risk of IBS. However, the results of the studies investigating the correlation between the intake of various food groups (milk, fruits, and vegetables) and IBS were not consistent. The association between cereal intake and the risk of

IBS depended on the type of the cereals and their gluten content. Eggs and fish have been reported to be among the foods that could decrease the risk of IBS although this finding has not been reported in all the studies in this regard.

There were some inconsistencies regarding the prevalence of IBS in various studies. For instance, one study reported the higher prevalence of IBS (35.5%), attributing the difference to the shared characteristics of the participants. The mentioned study was conducted on nurses and medical students, who had more stressful lives

compared to ordinary people. In addition, the irregular working hours of these individuals may affect their health and lead to the higher incidence of IBS (10).

IBS is a multifactorial disease, and several risk factors may play a role in its etiology. The biopsychosocial model has been most currently endorsed for IBS (13, 14). New research in this regard has demonstrated that diet affects the symptoms of IBS (5). With regard to the association between different foods and IBS, the current findings are not consistent in some food groups, while conclusive results have been yielded regarding many foods (e.g., processed meat and fast foods) (3, 5, 10).

According to the literature, allergic reactions could affect the incidence of IBS (2). In a study conducted by Zhaoqiu Zheng et al., the consumption of buckwheat noodles was associated with the higher prevalence of IBS due to the presence of allergenic proteins in buckwheat noodles, such as buckwheat 16- and 24-kDa, BW16KD, and BW24KD (8). In another research by Loan Chirila, a significant, positive association was reported between milk consumption and the risk of IBS. On the other hand, Katsuhisa Omagari claimed that milk intake was lower in the patients with IBS (4, 5). These contradictory findings may be due to the fact that in some patients, the symptoms of the disease might be caused by the consumption of certain foods (e.g., milk), which induce the production of IgG4. This antibody could be responsible for the symptoms of IBS, and in some patients, milk intolerance has also been reported. Therefore, these individuals often avoid drinking milk. Furthermore, lactose may cause IBS symptoms in some patients, and lactase deficiency must be medically confirmed by a hydrogen breath test (HBT) and not only based on the reports on the symptoms of the patient. According to a study in this regard, the prevalence of positive HBT was similar in the milk-tolerant and milk-intolerant patients with IBS (15, 16).

According to Loan Chirila et al., there was a significant association between the consumption of cereals and risk of IBS (5), which is most likely due to the gluten sensitivity of the patients with IBS. The prevalence of celiac disease has been

reported to be 0-32% in the patients with IBS (17). Due to the inducement of some human leukocyte antigens (e.g., HLA-DQ2 and HLA-DQ8), many patients with celiac disease may also show signs of gluten sensitivity. The probable mechanisms explaining the role of gluten in the occurrence of IBS symptoms is through the induction of gastrointestinal motility and increased permeability of the intestinal tract (2).

In a study examining the effects of gluten-free diets on the patients with IBS and without celiac disease and wheat allergy, the patients in the gluten intervention group scored significantly higher in terms of abdominal pain, bloating, and fatigue (18). On the other hand, the findings of another research indicated no significant association between the intake of rice, bread, and pasta and the prevalence IBS after adjustment for carbohydrate and plant proteins due to gluten sensitivity. Similarly, Japanese wheat noodles were reported to have no significant association with the prevalence of IBS before and after adjustment for carbohydrate and plant proteins, which could be due to the low levels of gluten in Japanese wheat noodles compared to rice and bread (8). However, another study indicated that Biobran (a substance derived from rice bran) is effective in improving the symptoms of IBS (19).

The gastrointestinal hormones that are secreted from the gastrointestinal tract in response to foods (e.g., motilin, cholecystokinin, peptide YY, and gastrin) often fluctuate in the patients with IBS. Peptide YY secretion increases after food intake in these patients, which could lead to visceral hypersensitivity and high concentrations of ghrelin in the circulation. This chain of actions may cause gastrointestinal motility disorders. In addition, cholecystokinin (CCK) increases after eating and during fasting, thereby leading to increased visceral hypersensitivity and pain. In response to fat and protein intake, CCK could be secreted from the proximal small intestine (2).

In a study conducted by Chirila et al., a significant, positive association was observed between the consumption of processed meat and risk of IBS. Similarly, Yukiko et al. reported that the female patients consumed significantly higher portions of processed food products compared to healthy individuals (5, 10). These findings might be due

to the high fat content in processed food products and processed meat, which triggers the production of CCK. The results of the mentioned study were consistent with the previous one, in which Watson explored the effects of low-fat diets on the prevalence of IBS in an interventional study, claiming that reducing the consumed amount of fats to 42 grams could significantly improve IBS symptoms (e.g., bloating). Moreover, in another study, the consumption of liquid meals containing 60% calories from fats has been reported to reduce the threshold of discomfort and pain, while the pain scores of patients in the visual analogue scale were observed to increase after the consumption of fatty meals (20, 21).

In a study by Okami et al., female IBS patients consumed significantly lower portions of fruits compared to healthy individuals, which could be due to the low threshold of fructose tolerance in the patients. Fructose cannot be absorbed in the colon and must be converted into short-chain fatty acids by micro flora, causing flatulence and bloating (2, 10). However, Chirila reported that the intake of fruits was associated with the higher risk of IBS, which might be due to the altered dietary patterns of these patients. In the mentioned research, dietary status was assessed using the food frequency questionnaire (FFQ), which might have overestimated the intake of vegetables, while the results of another study indicated that the FFQ underestimated the intake of fiber (5, 22, 23).

Conclusion

The results of this systematic review confirmed the key role of food compositions in the onset of IBS or its symptom deterioration in the patients. Therefore, it is recommended that patients with IBS reduce their intake of processed meat and fast food and pay more attention to the recommended dietary allowance of fruits and vegetables. However, the elimination of milk and cereals from the dietary patterns of IBS patients is not recommended unless diagnostic tests confirm lactase deficiency, allergic reactions or gluten sensitivity. IBS patients must be assessed individually, and dietary restrictions should be applied based on diagnostic tests results.

Funding source

The authors would like to thank to the Research Committee Shahid Beheshti University of Medical Sciences for supporting this research through fellowship funding the primary author.

Conflict of interest

All other authors report no conflicts of interest relevant to this article.

References

1. Guo YB, Zhuang KM, Kuang L, Zhan Q, Wang XF, Liu SD. Association between diet and lifestyle habits and irritable bowel syndrome: a case-control study. *Gut liver*. 2015; 9(5): 649-56.
2. Hayes PA, Fraher MH, Quigley EM. Irritable bowel syndrome: the role of food in pathogenesis and management. *Gastroenterol Hepatol (NY)*. 2014; 10(3): 164.
3. Khademolhosseini F, Mehrabani D, Nejabat M, Beheshti M, Heydari ST, Mirahmadizadeh A, et al. Irritable bowel syndrome in adults over 35 years in Shiraz, southern Iran: prevalence and associated factors. *J Res Med Sci*. 2011; 16(2): 200-6.
4. Omagari K, Murayama T, Tanaka Y, Yoshikawa C, Inoue S, Ichimura M, et al. Mental, physical, dietary, and nutritional effects on irritable bowel syndrome in young Japanese women. *Intern Med*. 2013; 52(12): 1295-301.
5. Chirila I, Petrariu FD, Ciortescu I, Mihai C, Drug VL. Diet and irritable bowel syndrome. *J Gastrointest Liver Dis*. 2012; 21(4): 357-62.
6. Sadeghi O, Khayyatizadeh SS, Esmailzadeh A, Hasanazadeh Keshteli A, Adibi P. A Study on the Relationship between Dietary Patterns and Prevalence of Irritable Bowel Syndrome. *Avicenna Journal of Clinical Medicine*. 2015; 22(3): 224-36.
7. Satake R, Sugawara N, Sato K, Takahashi I, Nakaji S, Yasui-Furukori N, et al. Prevalence and predictive factors of irritable bowel syndrome in a community-dwelling population in Japan. *Intern Med*. 2015; 54(24): 3105-12.
8. Zheng Z, Huang C, Guo Y, Niu K, Momma H, Kobayashi Y, et al. Staple foods consumption and irritable bowel syndrome in Japanese adults: a cross-sectional study. *PloS One*. 2015; 10(3): e0119097.
9. Hayes P, Corish C, O'mahony E, Quigley EM. A dietary survey of patients with irritable bowel syndrome. *J hum Nutr Diet*. 2014; 27 Suppl 2: 36-47.
10. Okami Y, Kato T, Nin G, Harada K, Aoi W, Wada S, et al. Lifestyle and psychological factors related to irritable bowel syndrome in nursing and medical school students. *J Gastroenterol*. 2011; 46(12): 1403-10.
11. Buscail C, Sabate JM, Bouchoucha M, Kesse-Guyot E, Hercberg S, Benamouzig R, et al. Western dietary

pattern is associated with irritable bowel syndrome in the French NutriNet cohort. *Nutrients*. 2017; 9(9): E986.

12. Torres MJ, Sabate JM, Bouchoucha M, Buscail C, Hercberg S, Julia C. Food consumption and dietary intakes in 36,448 adults and their association with irritable bowel syndrome: Nutrinet-Sante study. *Therap Adv Gastroenterol*. 2018; 11: 1756283X17746625.

13. Drossman DA. Irritable bowel syndrome: A multifactorial disorder. *Hosp Pract*. 1988; 23(9): 119-33.

14. Chey WD, Kurlander J, Eswaran S. Irritable bowel syndrome: a clinical review. *JAMA*. 2015; 313(9): 949-58.

15. Zar S, Mincher L, Benson MJ, Kumar D. Food-specific IgG4 antibody-guided exclusion diet improves symptoms and rectal compliance in irritable bowel syndrome. *Scand J Gastroenterol*. 2005; 40(7): 800-7.

16. Vernia P, Marinaro V, Argnani F, Di Camillo M, Caprilli R. Self-reported milk intolerance in irritable bowel syndrome: what should we believe? *Clin Nutr*. 2004; 23(5): 996-1000.

17. Heizer WD, Southern S, McGovern S. The role of diet in symptoms of irritable bowel syndrome in adults: a narrative review. *J Am Diet Assoc*. 2009; 109(7): 1204-14.

18. Zanwar VG, Pawar SV, Gambhire PA, Jain SS, Surude RG, Shah VB, et al. Symptomatic improvement with gluten restriction in irritable bowel syndrome: a

prospective, randomized, double blinded placebo controlled trial. *Intest Res*. 2016; 14(4): 343-50.

19. Kamiya T, Shikano M, Tanaka M, Ozeki K, Ebi M, Katano T, et al. Therapeutic effects of biobran, modified arabinoxylan rice bran, in improving symptoms of diarrhea predominant or mixed type irritable bowel syndrome: a pilot, randomized controlled study. *Evid Based Complement Alternat Med*. 2014; 2014: 828137.

20. Watson L, Lalji A, Bodla S, Muls A, Andreyev HJ, Shaw C. Management of bile acid malabsorption using low-fat dietary interventions: a useful strategy applicable to some patients with diarrhoea-predominant irritable bowel syndrome? *Clin Med (Lond)*. 2015; 15(6): 536-40.

21. Simrén M, Agerforz P, Björnsson ES, Abrahamsson H. Nutrient-dependent enhancement of rectal sensitivity in irritable bowel syndrome (IBS). *Neurogastroenterol Motil*. 2007; 19(1): 20-9.

22. Shrestha A, Koju RP, Beresford SAA, Chan KCG, Connell FA, Karmacharya BM, et al. Reproducibility and relative validity of food group intake in a food frequency questionnaire developed for Nepalese diet. *Int J Food Sci Nutr*. 2017; 68(5): 605-12.

23. Vuholm S, Lorenzen JK, Kristensen M. Relative validity and reproducibility of a food frequency questionnaire to assess dietary fiber intake in Danish adults. *Food Nutr Res*. 2014; 58(1): 24723.